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3M INNOVATIVE PROPERTIES COMPANY
PO BOX 33427
ST. PAUL, MN 55133-3427

EXAMINER

TSOY, ELENA

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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/853,217

Filing Date: May 11, 2001

Appellant(s): WEISS ET AL.

Daniel M. Pauly
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed July 30, 2007 appealing from the Office action mailed October 20, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct. Note, however, that the title "VI. ISSUES PRESENTED FOR REVIEW" in Appellants' Brief should be "VI. Grounds of Rejection to be Reviewed on Appeal".

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

WO 00/04055	WEISS ET AL	1-2000
4,163,172	LODA	7-1979
4,886,840	MUKOHYAMA ET AL	12-1989

Botman, J.I.M. "A Linear Accelerator as a Tool For Investigations into Free Radical Polymerization Kinetics and Mechanisms by Means of Pulsed Electron Beam Polymerization" Nuclear Instruments and Methods in Physics Research B, Vol139 (1998), pp. 490-494

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Weiss et al (WO 00/04055) in view of Loda (US 4,163,172), Mukohyama et al (US 4,886,840) and Botman et al (Nuclear Instruments and Methods in Physics Research B 139, 1998).

Weiss et al disclose a polymerization method comprising coating a substrate with an adhesive syrup (polymerizable composition) (See page 14, lines 15-25) and irradiating the polymerizable composition with a beam of accelerated electrons to polymerize said polymerizable composition (See Abstract) to produce long-chain polymers with limited crosslinking over a broad range of coated thicknesses for use as pressure-sensitive adhesives and with high conversion (See page 3, lines 1-12). The polymerizable composition comprises polymerizable C₈-C₁₃-alkyl acrylate monomers selected from the group consisting of isooctyl acrylate, 2-ethylhexyl acrylate, lauryl acrylate and tridecyl acrylate (See page 3, lines 27-32), a comonomer selected from the group consisting of acrylic acid, isobornyl acrylate, octylacrylamide and n-vinyl pyrrolidone (See page 7, lines 15-24), crosslinking agents (See page 8) and a thickening agent (See page 15, line 28).

Weiss et al teach that the desired high conversion and long-chain polymers with limited crosslinking can be achieved by maintaining the temperature of the adhesive syrup at a temperature below 20⁰C e.g. at between -80 ⁰C and 10 ⁰C during polymerization (See page 11, lines 1-12), and by decreasing the flux of electrons (current) (i.e. using low rate of initiation that produces low concentration of radicals) (See page 11, lines 24-25) because the high rate of initiation produces high concentration of radicals, which lead to a comparatively large number of terminations resulting in lower molecular weight and a lower conversion of monomer to polymer (See page 11, lines 19-23). The desired *total dose* with the use of decreased flux of electrons (current) can be achieved by increasing the residence time under the beam (See page 11, lines 25-

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30). The total dose primarily affects the extent of conversion of monomer to polymer (See page 12, lines 19-22). Polymerization was effected at total doses ranging from 5-80 kGy (See page 36, line 4) or 20 to 100 kGy (See Abstract) using dose rates ranging from 0.125 to 29 kGy/sec (**125 Gy/sec –29000 Gy/sec**) (See page 36, lines 3-5).

Thus, Weiss et al teach **general conditions** of claimed invention for producing desired long-chain polymers: (i) the use of **decreased flux of electrons** (versus high rate of initiation that produces high concentration of radicals); (ii) the use of the low temperature, e.g. below 20°C, (iii) the use of high dose rates of up to **29000 Gy per second** except for the use of pulsed e-beam.

As to the use of pulsed e-beam, Weiss et al teach that *a number of different methods* can be employed to provide the desired dose and residence time **such as** a method that employs a shuttle system communicating with an *on-off* switch for the electron beam generator (See page 11, line 31 to page 12, line 10). In other words, Weiss et al do not limit their teaching to a particular e-beam to carry out their invention. Therefore, it would be obvious to one of ordinary skill in the art to use *either* a continuous *or* a pulsed e-beam for carrying out polymerization.

Thus, it would be obvious to one of ordinary skill in the art to use pulsed e-beam with decreased flux of electrons that is capable of delivering high dose rates of up to 29000 Gy per second, i.e. having high pulse rate.

However, Weiss et al fail to teach that *pulsed* electron beam with *decreased flux of electrons* has a dose per pulse of about 10 to about 90 Gy (Claim 1) or about 10 to about 40 Gy (Claim 11) or of about 10 to about 30 Gy (Claim 13); a residence time of about 1.5 seconds to about 5 seconds (Claim 10), at a pulse rate equal to or greater than about 500 (Claim 1) or of 500 to about 3,000 pulses per second (Claim 12).

It is well settled that optimization *within prior art conditions* or through routine experimentation will not support the patentability of subject matter encompassed by the prior art in the absence of criticality. “Where *the general conditions of a claim are disclosed in the prior art*, it is not inventive to discover the optimum or workable ranges by routine experimentation.” *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant dose per pulse and pulse rate parameters (including those of

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claimed invention) in Weiss et al through routine experimentation depending on particular application in the absence of showing of criticality.

The following references are relied by the Examiner to show state of the art in using *pulsed* electron beam to cure electron beam curable compositions. Loda shows that polymerization is affected not only by the total dose of radiation, but also by the rate at which the dose is delivered: the high dose rate of *very short pulses*, of the order of *microseconds* (high frequency of at least 500 pulses per second), elicits chemical reactions, which may be different from those produced by the impact of long pulses or continuous radiation (See column 1, lines 53-60). Mukohyama et al show that a total dose of 0.75 Mrad - 3 Mrad (75 Gy –300 Gy) can be delivered at a dose per pulse of 0.75 Mrad (75 Gy) (See column 10, lines 16-30) for electron beam curing (polymerizing) 65 micron thick coating of a composition comprising a polyester acrylate or epoxy acrylate prepolymer, a difunctional acrylic monomer, acryloylmorpholine as a reactive diluent. Botman et al show that free radical polymerization of an acrylic monomer on seed latex can be achieved using pulses of accelerated electrons at dose per pulse of 0.92 Gy at pulse rate of 25 Hz (pulse per sec) with a total dose of 1700 Gy (See page 493, paragraph 4.2, column 2) or pulses of 50 Hz and 3 Gy per pulse (See Abstract); and *homogeneous* polymerization of styrene requires total dose of 6700 Gy at a pulse frequency of 25 Hz and dose per pulse of 2.3 Gy (See page 493, column 1, paragraph 4.2, lines 1-5). Botman et al also teach that the total dose depends on the overall irradiation time and the dose per pulse (at a given pulse rate) (See page 492, column 1, paragraph 3, lines 1-3).

Thus, the cited prior art shows that *pulsed* electron beam having decreased doses per pulses, e.g. within a range of e.g. 0.92-75 Gy per pulse and *pulsed* electron beam having either long pulses or *very short pulses*, of the order of *microseconds* (high frequency of at least 500 pulses per second) are known to be used for polymerization of an electron curable composition.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used pulsed electron beam at doses per pulses within a range of e.g. 0.92-75 Gy per pulse for polymerization of an electron beam curable composition in Weiss et al since the cited prior art shows that polymerization of an electron curable composition can be achieved using either continuous electron beam or pulsed electron beam, and Weiss et al do not limit their teaching to a particular e-beam, pulsed or continuous or to particular decreased flux of electrons

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for achieving a total doses ranging from 5 to 80 kGy using dose rates ranging within 125 Gy/sec – 29000 Gy/sec.

As to at least 500 pulses per second, it could be shown by simple math that to achieve dose rates of Weiss et al ranging within 125 Gy/sec – 29000 Gy/second using e.g.

1 Gy/pulse for simplicity of calculation, pulse rate should be within the range of **125-29000 pulses per second**.

Thus, the cited prior art also shows that pulsed electron beam polymerization can be achieved by varying not only the total dose of radiation, but also varying dose per pulse (as shown by Loda), using, for example, 0.92 Gy per pulse (as shown by Botman et al) or 75 Gy (as shown by Mukohyama et al). It is well known in the art that the total dose (D) depends on pulse frequency (F), dose per pulse (dpp) and residence time (t), i.e. $D = F \cdot dpp \cdot t$ or (dose rate) $\cdot t$. Therefore, dose per pulse and residence time limitations are result-effective parameters in an electron beam curing (polymerization) process.

It is held that it is not inventive to discover the optimum or workable ranges of result-effective variables by routine experimentation. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). See also In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

As to claimed pulse rate of 500 to about 3,000 pulses per second, it would have also been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant dose per pulse parameters (including those of claimed invention), e.g. within prior art range of 0.92 Gy per pulse - 75 Gy per pulse, and the optimum values of the relevant pulse rate parameters (including those of claimed invention) in Weiss et al through routine experimentation depending on particular electron beam curable composition, thickness, etc., in the absence of a showing of criticality.

Moreover, as was discussed above, Weiss et al teach a total doses ranging from 5 to 80 kGy is applied using a decreased flux of electrons, and dose rates ranging within 125 Gy/sec – 29000 Gy/sec. Clearly, to apply 125 Gy/sec – 29000 Gy/sec using a *decreased* flux of electrons, one should use e-beam at a very high pulse rate. For example, at a dose per pulse of 1 Gy, pulse rate within a range of **125 pulse/sec – 29000 pulse/sec** would be required to achieve dose rates within a range of 125 Gy/sec – 29000 Gy/sec; or at a dose per pulse of 10 Gy, pulse rate within a range of 12.5 pulse/sec – 2900 pulse/sec would be required to achieve dose rates within a range of

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125 Gy/sec – 29000 Gy/sec. Furthermore, since the total dose (D) depends on pulse frequency (F), dose per pulse (dpp) and residence time (t), i.e. $D = F \cdot \text{dpp} \cdot t$ or (dose rate) $\cdot t$, the total doses of 100 kGy as in Weiss et al, for example, would be achieved at dose per pulse of 75 Gy (as shown by Mukohyama et al) and residence time of 1.5- 2 seconds with 889-667 pulses per second. At dose per pulse of e.g. 10 Gy, the same total doses of 100 kGy as in Weiss et al would be achieved with 667 pulses per second but at residence time of 15 sec.

As claimed heterogeneous single phase e-beam polymerization, it is the Examiner's position that e-beam polymerization of Weiss et al is a heterogeneous single phase e-beam polymerization *inherently*. Weiss et al **expressly** teach that by conducting e-beam polymerization at **temperatures below 20⁰C**, using **decreased** flux of electrons (i.e. using **low rate of initiation** that produces low concentration of radicals) (See page 11, lines 24-25) the rate of polymer chain propagation is increasingly favored over the rate of termination, with the effect of achieving higher conversion and producing polymers having *high molecular weight between crosslinks* that provides the necessary balancing of viscous and elastic properties required for a pressure-sensitive adhesive (See page 2, lines 3-10). Weiss et al teach that the rate of termination is generally proportional to the concentration of radicals, with a comparatively large number of terminations at high radical concentrations that results in lower molecular weight and a lower conversion of monomer to polymer (See page 11, lines 19-23) producing short-chain, branched, highly crosslinked polymeric structures (See page 3, lines 8-12). As described in the Applicants' disclosure on page 2, lines 3-7, and page 6, lines 20-21), e-beam polymerization produces highly gelled polymers of adequate chain lengths between crosslinks over a broad range of coated thicknesses only when it is carried out *heterogeneously in a single phase* in contrast to homogeneous e-beam polymerization which produces short-chain, branched, highly crosslinked polymeric structures (See specification, page 4, lines 8-32). Moreover, it is the Examiner's position that the method of Weiss et al in view of Loda, Botman et al and Mukohyama et al would cure (polymerize) electron beam curable composition heterogeneously in a single phase since the method would be substantially identical to that of claimed invention.

(10) Response to Argument

(A) Applicants state that Claim 1 is not obvious over cited prior art. Applicants have discovered that the manner in which the electron beam dose is delivered can have dramatic effects

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on the polymerization process itself. Specifically, when the dose per pulse is relatively low (e.g. about 10 to 90 Gy) and the pulse rate is below 500 Hz, the reaction takes place primarily in the homogenous mode because of the longer time intervals between pulses (diffusion). As the frequency of the pulses is increased above about 500 Hz, the heterogeneous mode of polymerization becomes more dominant, because the shorter interval between pulses increasingly favors heterogeneous kinetics (see pp. 13-14 of the specification). This surprising and unexpected discovery is not appreciated or otherwise made obvious anywhere in the art of record.

The Examiner respectfully disagrees with this argument. First of all, polymerization described by Weiss et al is in fact heterogeneous single phase e-beam polymerization because it produces *long-chain polymers with limited crosslinking* with high conversion in contrast to polymerization (homogeneous polymerization) with high rate of initiation, which lead to a comparatively large number of terminations resulting in lower molecular weight and a lower conversion of monomer to polymer. Second, Weiss et al teach the use of electron beam having high dose rates of up to **29000 Gy per second**. Weiss et al do not limit their teaching to a continuous e-beam to carry out their invention, i.e. Weiss et al do not exclude the use pulsed e-beam. In other words, pulsed e-beam of Weiss et al having **decreased flux of electrons** should have at least 500 pulses per second to deliver up to **29000 Gy per second**. Note that it is a *common knowledge* in the art that an electron beam may be generated as a timed pulse of microseconds in duration, i.e. with a repetition rate of 500 pulses per second, as evidenced by Loda.

Thus, Weiss et al teach *general conditions* of claimed invention for producing desired long-chain polymers: (i) the use of **decreased flux of electrons** (versus high rate of initiation that produces high concentration of radicals); (ii) the use of the low temperature, e.g. below 20°C (iii) the use of high dose rates of up to **29000 Gy per second**. Third, Weiss et al do not exclude pulsed e-beam to carry out their invention. Therefore, it would be obvious to one of ordinary skill in the art to use pulsed e-beam with decreased flux of electrons that is capable of delivering high dose rates of up to 29000 Gy per second, i.e. having high pulse rate.

It is well settled that optimization **within prior art conditions** or through routine experimentation will not support the patentability of subject matter encompassed by the prior art in the absence of criticality. "Where *the general conditions of a claim are disclosed in the prior*

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art, it is not inventive to discover the optimum or workable ranges by routine experimentation.” In *re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955) (Claimed process which was performed at a temperature between 40°C and 80°C and an acid concentration between 25% and 70% was held to be *prima facie* obvious over a reference process which differed from the claims only in that the reference process was performed at a temperature of 100°C and an acid concentration of 10%.); see also *Peterson*, 315 F.3d at 1330, 65 USPQ2d at 1382 (“The normal desire of scientists or artisans to improve upon what is already generally known provides the motivation to determine where in a disclosed set of percentage ranges is the optimum combination of percentages.”); In *re Hoeschele*, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969) (Claimed elastomeric polyurethanes which fell within the broad scope of the references were held to be unpatentable thereover because, among other reasons, there was no evidence of the criticality of the claimed ranges of molecular weight or molar proportions.).

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant dose per pulse and pulse rate parameters (including those of claimed invention) in *Weiss et al* through routine experimentation depending on particular application in the absence of showing of criticality.

(B) Applicants argue that nothing in the cited references indicates that the devices for generating e-beams described therein should even have been capable of providing pulse frequencies greater than or equal to 500 Hz. For example, the upper range limit described in *Botman* is 50 Hz, far below the 500 Hz recited in the present claims. The Examiner appears to assert that it is possible, using *Mukohyama*, to derive the teaching of pulses in the range of 500 to 3,000 Hz, but Applicants are unable to identify such teaching in *Mukohyama*.

The Examiner respectfully disagrees with this argument. First of all, the Examiner never used *Mukohyama* to derive the teaching of pulses in the range of 500 to 3,000 Hz. Second, the Examiner cited *Loda* (not *Mukohyama*) that *pulsed* e-beam having *very short pulses*, of the order of *microseconds* (high frequency of at least **500 pulses per second**) are known to be used for polymerization of an electron curable composition. Moreover, it should be noted that the Examiner’s statement that *Loda* teaches e-beam capable of providing at least **500 pulses per second** was not adequately traversed by Applicants (See Remarks submitted on 9/13/2005). Since the Examiner’s statement about *Loda*’s e-beam being capable of providing at least 500 pulses per

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second was not adequately traversed by Applicants, it is assumed that Applicants admitted the statement being true.

(C) Applicants state that Mukohyama fails to make obvious the claimed invention because it merely teaches curing resins into a hard coat, which is not analogous to polymerizing monomers into a tacky adhesive, especially a high quality adhesive as taught in the instant application.

The argument is unconvincing because Mukohyama is a secondary reference which is relied upon to show that it is known in the art to use claimed low doses per pulse for curing electron beam curable compositions.

(D) Applicants respectfully disagree with the Examiner assertion that "e-beam polymerization of Weiss et al is inherently a heterogeneous single phase e-beam polymerization". Although Weiss teaches a polymerization method for forming a pressure sensitive adhesive, the present invention further improves upon Weiss by teaching the specific polymerization method comprising providing a substrate; coating at least a portion of said substrate with a polymerizable composition; providing an electron beam that is capable of producing pulses of accelerated electrons; and irradiating said polymerizable composition with said pulses of accelerated electrons thereby heterogeneously polymerizing said polymerizable composition in a single phase, said pulses of accelerated electrons having a dose per pulse of about 10 to about 90 Gy, wherein said composition is irradiated with said pulses of accelerated electrons at a pulse rate equal to or greater than about 500 pulses per second. Even if Weiss is asserted to teach heterogeneous polymerization, nothing in Weiss teaches pulses of accelerated electrons. Based upon the prior art teachings, one would merely seek to adjust total dose, without appreciating the benefits of the use of low doses at high frequencies.

The Examiner respectfully disagrees with this argument. As was discussed above, Weiss et al teach substantially the same general conditions of e-polymerization to produce substantially identical polymers having *high molecular weight between crosslinks* that provides the necessary balancing of viscous and elastic properties required for a pressure-sensitive adhesive (See page 2, lines 3-10). Note that Applicants' own disclosure on page 2, lines 3-7, and page 6, lines 20-21) discloses that e-beam polymerization produces highly gelled polymers of adequate chain lengths between crosslinks over a broad range of coated thicknesses only when it is carried out

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heterogeneously in a single phase in contrast to homogeneous e-beam polymerization which produces short-chain, branched, highly crosslinked polymeric structures (See specification, page 4, lines 8-32). Therefore, e-polymerization of Weiss et al that produces polymers substantially identical to those claimed invention, i.e. polymers having *high molecular weight between crosslinks* that provides the necessary balancing of viscous and elastic properties required for a pressure-sensitive adhesive, is in fact heterogeneous single phase e-beam polymerization.

(E) Applicants state that in contrast to the prior art methods of producing heterogeneous polymerization, the present invention includes a method of producing heterogeneous polymerization by having a low dosed pulse and a high pulse rate. The Examiner refers to Applicants' disclosure at page 2, lines 3-7 for the proposition that heterogeneous e-beam polymerization produces highly gelled polymers of adequate chain lengths between crosslinks. However, the Examiner overlooks the further assertion at page 2, lines 7-10 that three known methods of achieving heterogeneous polymerization include emulsion, solid phase catalysis, and precipitating conditions, and that all three of these methods involve phase separation to maintain the heterogeneous conditions. The present invention claims a totally new, highly efficient and unexpected way to achieve the advantage of heterogeneous polymerization in a single phase system.

The Examiner respectfully disagrees with this argument. First of all, in contrast to Applicants statement, polymerization of Weiss et al is a **single phase** polymerization, and does not include emulsion, solid phase catalysis, and precipitating conditions. Second, polymerization of Weiss et al is (heterogeneous) polymerization having decreased flux of electrons (i.e. a **low dosed pulse**) and a **high dose rate** because electron beam should be capable of delivering up **up 29000 Gy per second**.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

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For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Elena Tsoy, Ph.D.
Primary Examiner
Art Unit 1762
September 18, 2007

ELENA TSOY
PRIMARY EXAMINER



Conferees:

Timothy Meeks



TIMOTHY MEESKS
SUPERVISORY PATENT EXAMINER

Jennifer Kolb-Michener



JENNIFER MICHENER
QUALITY ASSURANCE SPECIALIST